Recent Marshall Space Flight Center Natural Environments Branch Activities Supporting the Exploration Mission-1 Launch

March 2016 Natural Environments
Day-of-Launch Working Group
Meeting

Barry Roberts

Exploration Mission-1 (EM-1) Program Outline

- EM-1 Launch planned for late 2018
- There are three programs under the Exploration Systems Development Division (ESD) at NASA HQ working toward the launch
  - Space Launch System (SLS)
  - Orion Multi Purpose Crew Vehicle (MPCV)
  - Ground Systems Development and Operations (GSDO)
  - Also, ESD has a Cross-Program function to ensure all the programs are integrated for the EM-1 launch

MSFC NE Branch Cross-Program Support Activities

- Released Revision D of SLS-SPEC-159 'Cross-Program Design Specifications for Natural Environments' on 12 November 2015
  - Section 3.3.1.2.2: Update the environment specification for radiation belt transit for Trans-Lunar Insertion, as requested by Orion Multi-Purpose Crew Vehicle, because it was overly conservative
  - Section 3.2.5 & 3.5.4: Allow the use of newer 2013 Range Reference Atmospheres in the Earth Global Reference Atmospheric Model 2010
  - Section 3.2.11: Update the fauna environment to correspond with the environment used for the SLS/Orion MPCV bird strike Probabilistic Risk Analysis, in response to SLS CDR RID SLSC-0069
  - Section 3.1.10: Update reference for fungus growth testing from MIL-STD-810F to MIL-STD-810G (No change in the environment specification.)
  - Section 3.1.3: Clarify use of a natural log function vs base-ten log function in equation for the ground wind profile (No change in the environment specification.)

MSFC NE Branch SLS Support Activities

- Provided thermal environments (temperature, sky temperature, solar insolation) to support assessments of ice growth on MPCV/Spacecraft Adaptor (MSA) and frost growth on SLS cameras (intertank and engine sections)
- Supporting interim Cryogenic Propulsion System (iCPS) disposal assessments (will GPS units function properly in ionizing radiation environment?)
- Determine options, and recommend method for liftoff wind LCC evaluation
  - SLS is designed to peak wind profile (surface to 500-ft)
  - Previously, pad 39B had only 60-ft measurements (which have been removed)
  - Lightning Protection System (LPS) now provides wind measurements at 39B
    - Four heights from 132 to 457 ft
    - Evaluate all four heights, or just the lowest height?
      - Pros and cons to each
      - MSFC NE working with SLS Engineering to determine best approach

MSFC NE Branch Orion MPCV Support Activities

- Developed buoy-based wave spectra environments for use in Crew Module Uprighting System assessments
  - More robust environment definition versus theoretical spectra
  - Small sample size was needed to minimize analysis time
- Provided software to Orion aborts to randomly select a water depth at a landing location based on gridded water depth statistics provided by the United States Geological Survey
- Generated monthly maps of best, average, and worst sea conditions within the EM-2 weather alternate recovery zone to the Spaceflight Meteorology Group as part of a brief to the Landing and Recovery Integrated Task Team
- Assessed low-level wind shears to support vehicle oscillation studies